Total Blackout: Finding Power for the Lake Oswego-Tigard WTP During the Ice Storm

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carollo®

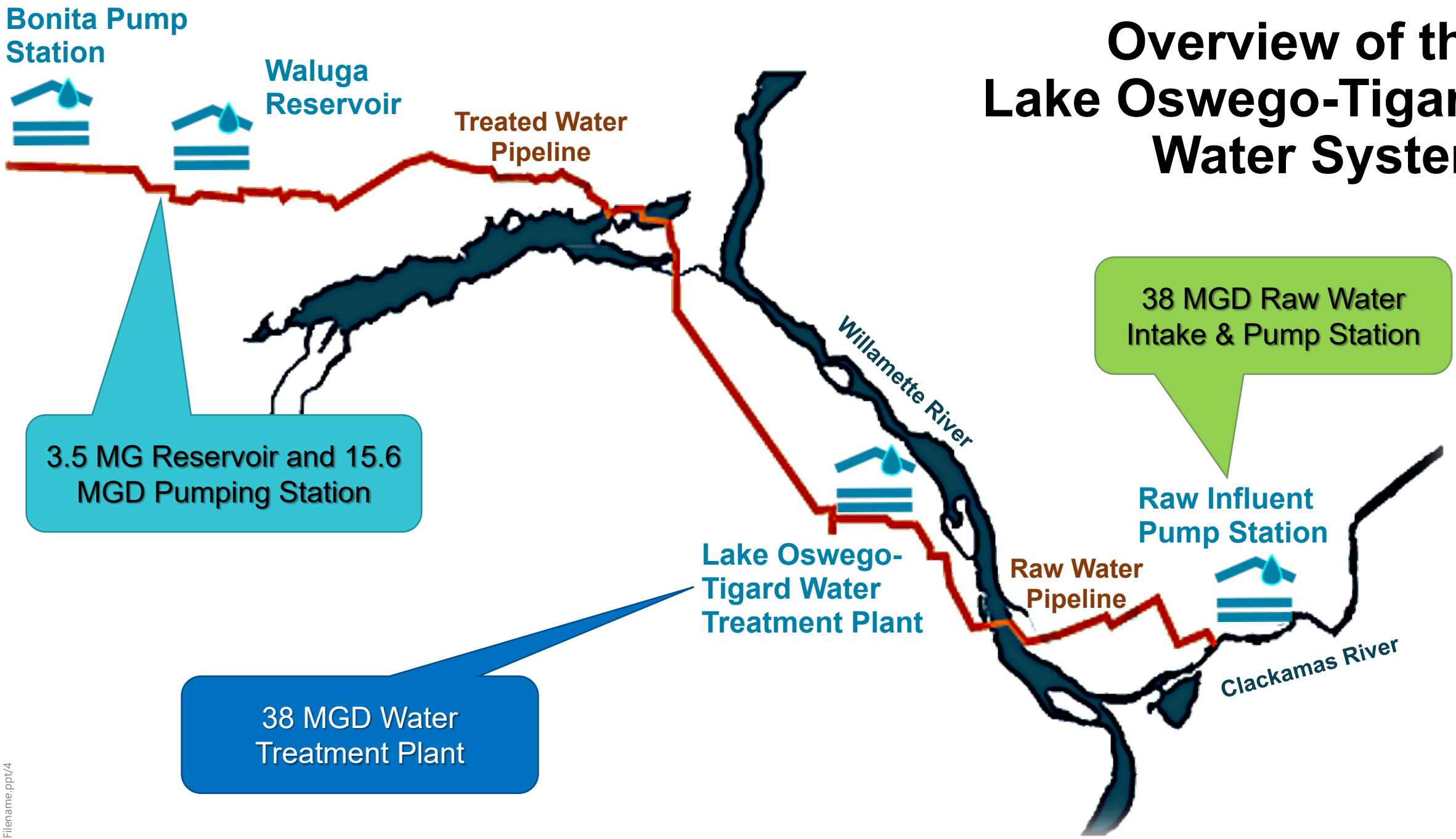
PNWS-AWWA Tacoma // April 2022

AGENDA

- A Brief History of the Lake-Oswego-Tigard Water Partnership
- President's Day Storm: Sequence of Events
- Long Term Standby Power Solutions
- Summary and Lessons Learned

A Brief History of the
Lake-Oswego-Tigard Water Partnership

Overview of the Lake Oswego-Tigard Water System



Quick Facts about the Raw Influent Pump Station (RIPS)

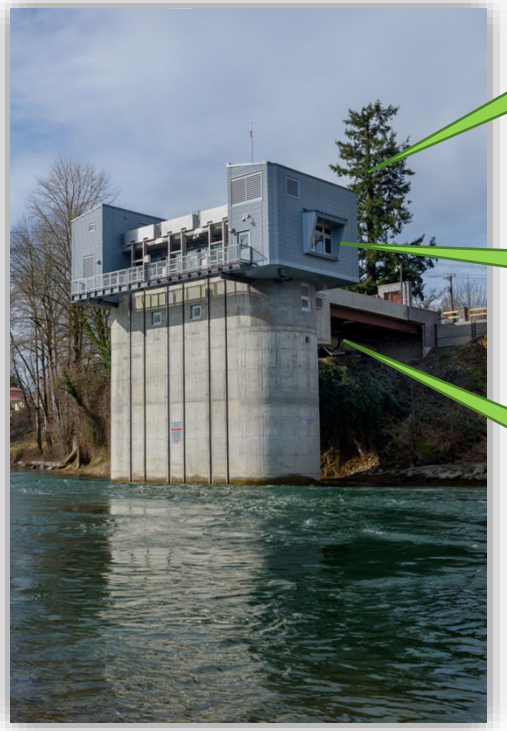
- Located in the Clackamas River
- 3 Rotating drum fish screens
- 5 vertical turbine influent pumps (9.5 mgd / 400 HP, each)

Quick Facts about the Plant

- 38 MGD capacity
- Conventional treatment with Actiflo®, Ozone, and deep bed dual media filtration
- 2MG clearwell with 5 finished water pumps (7.8 mgd / 600 HP, each)

Original design standby power strategy

- 2 feeds, 2 locations, a baby generator and a backup battery



Power Feed A

Backup Systems Battery

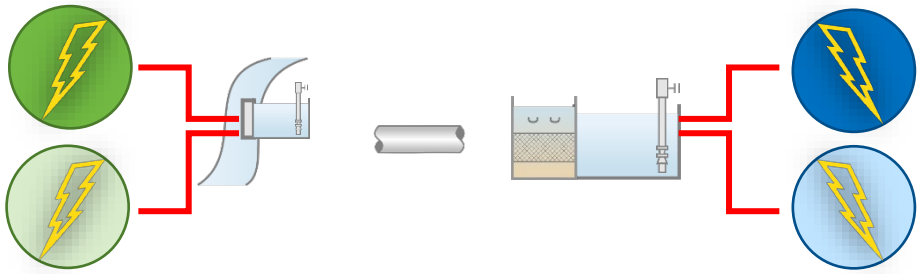
Power Feed B

Power Feed C

Power Feed D

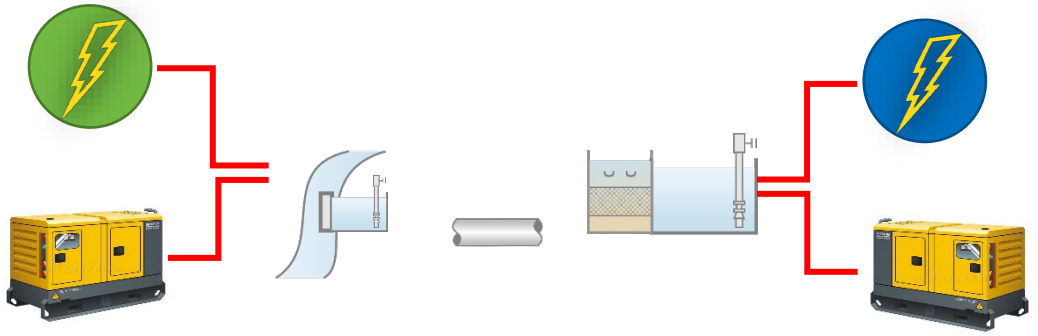
Small Backup Generator

Why Two Power Feeds?



Benefits of Dual Power Feeds:

- Faster switchover between feeds
- Does not require on-site fuel storage
- Minimal annual maintenance
- Utility data indicated loss of power for both feeds feeding each location was extremely rare



Concerns with Conventional Diesel Standby Power:

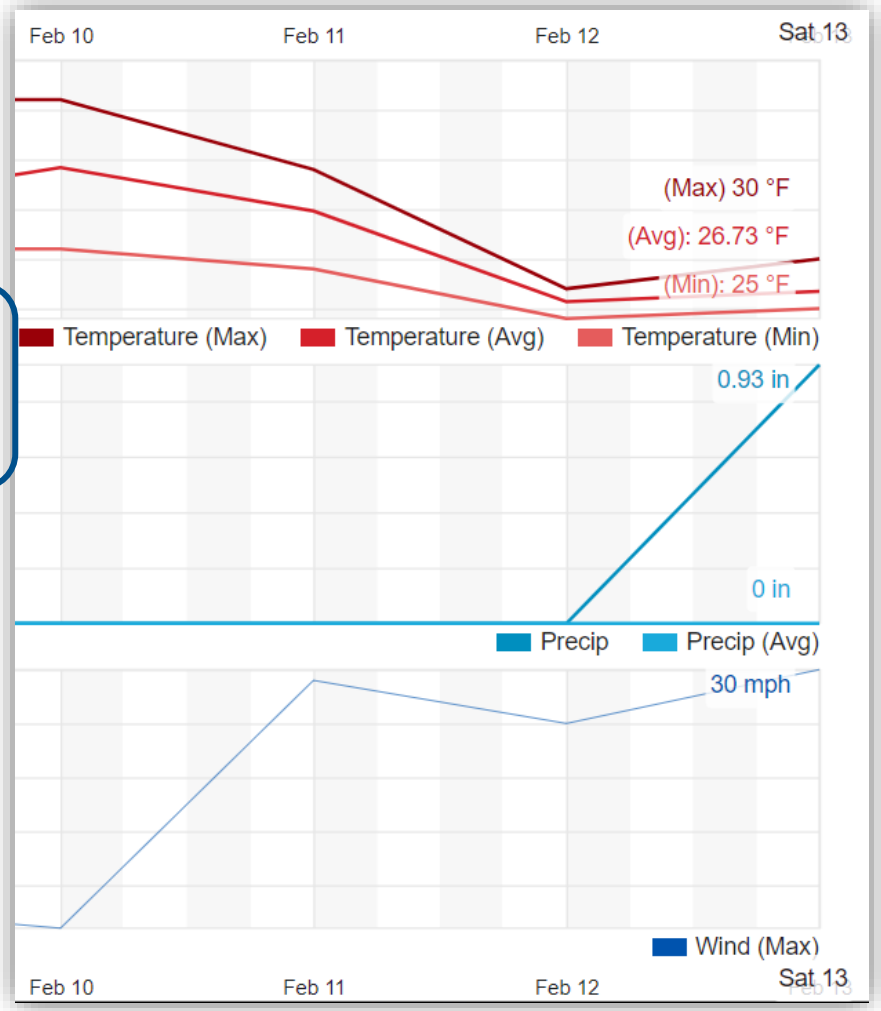
- Land Use and Footprint Concerns
- Stored fuel needs to be periodically reconditioned
- Noise, traffic, maintenance
- Environmental / Carbon footprint impacts

President's Day Storm 2021
Sequence of Events

Sequence of Events: **The Storm**

Filled reservoirs in preparation

Temperatures drop, precipitation starts, wind gusts to 30 MPH



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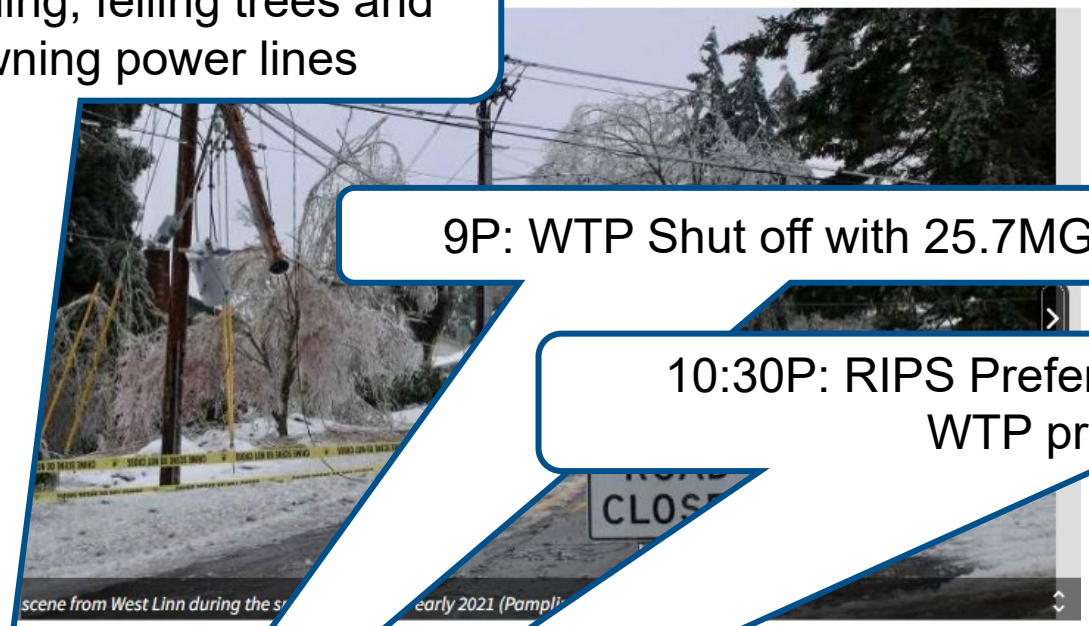
Sequence of Events: **The Storm**

Snow and ice cover everything, felling trees and downing power lines



9P: WTP Shut off with 25.7MG in storage

10:30P: RIPS Preferred and Alternate supplies lost
WTP preferred supply lost

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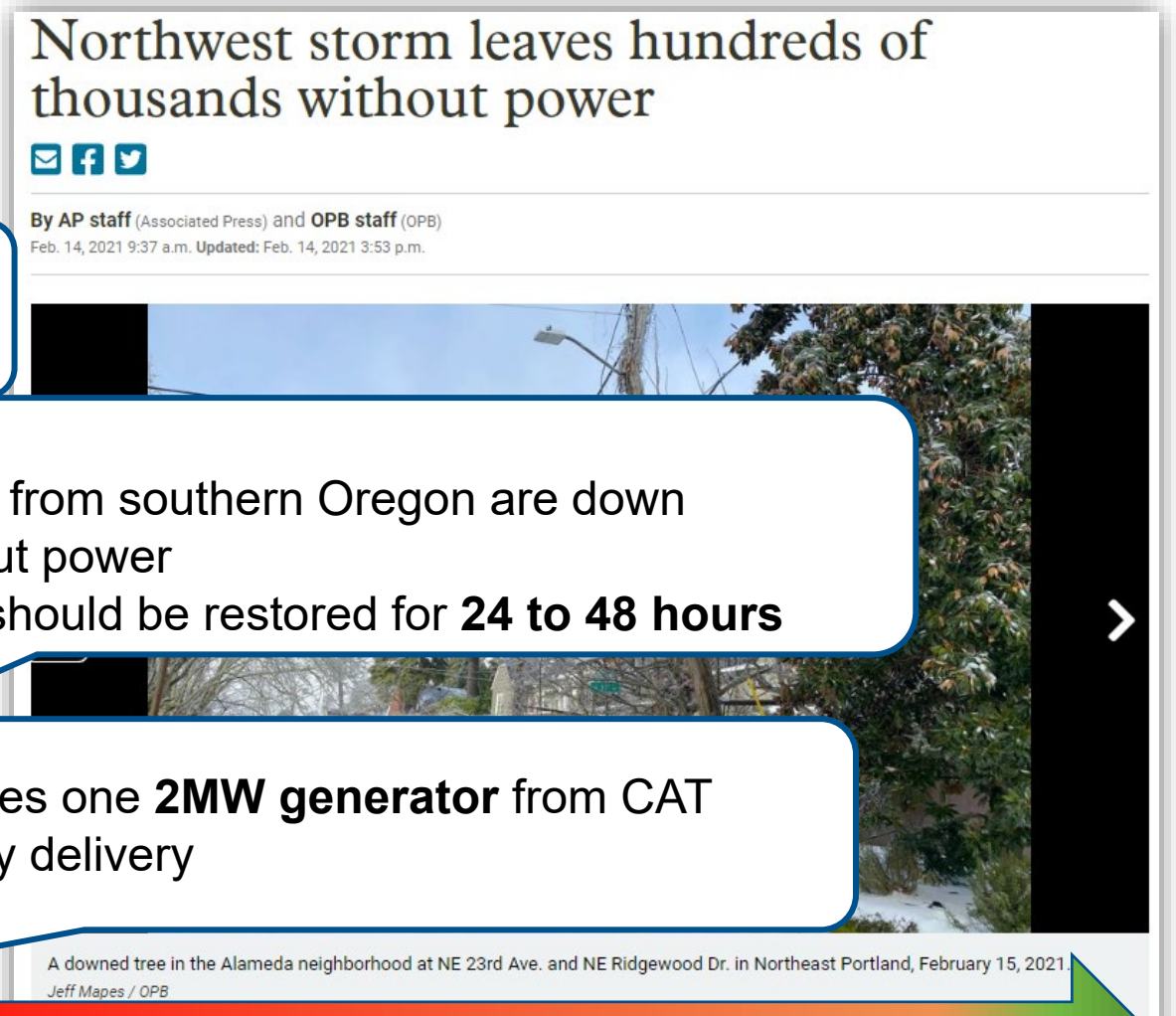
Sequence of Events: **The Storm**

No Power at RIPS
WTP on **Alternate Power**

Engaged EC Electric to **find generator** for RIPS

PGE Reports:
- main transmission lines from southern Oregon are down
- 3 substations are without power
- Power to **substations** should be restored for **24 to 48 hours**

8P: EC Electric locates one **2MW generator** from CAT Peterson for next day delivery



Northwest storm leaves hundreds of thousands without power

By AP staff (Associated Press) and OPB staff (OPB)
Feb. 14, 2021 9:37 a.m. **Updated:** Feb. 14, 2021 3:53 p.m.

A downed tree in the Alameda neighborhood at NE 23rd Ave. and NE Ridgewood Dr. in Northeast Portland, February 15, 2021.
Jeff Mapes / OPB

2/11 2/12 2/13 2/14 2/15 2/16 2/17 2/18 2/19 2/20 2/21 2/22 2/23 2/24

Sequence of Events: **Total Blackout**

7:30A: EC Electric at RIPS ready to connect generator, but delivery is hampered by **road conditions, downed trees and powerlines**

Road Conditions at RIPS

A large tree blocks Bybee Road which connects Eastmoreland and Sellwood in Portland on Monday. Nearly every block in Woodstock and Eastmoreland has tree limbs and power lines down as thousands remained without power.

Michael Bendixen / OPB

2/11 2/12 2/13 2/14 2/15 2/16 2/17 2/18 2/19 2/20 2/21 2/22 2/23 2/24

Sequence of Events: **Total Blackout**

11A: Generator shows up at RIPS
EC gets to wiring

1:30P **WTP loses alternate** p
Second 2MW generator locate

8P: RIPS standby power generator wiring complete

2/11 2/12 2/13 2/14 2/15 2/16 2/17 2/18 2/19 2/20 2/21 2/22 2/23 2/24

Sequence of Events: **Total Blackout**

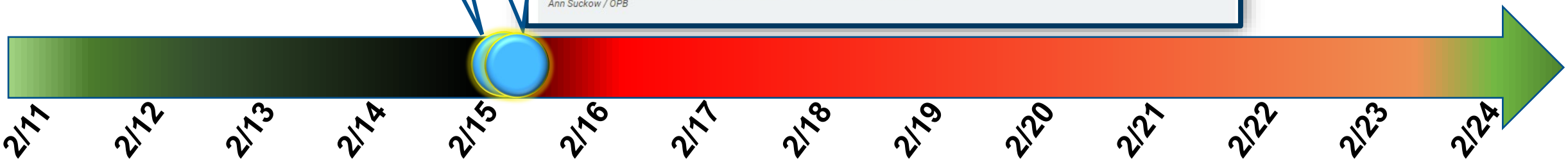
7:30A: EC Electric at WTP ready to connect generator, but delivery is hampered by **road conditions, downed trees and powerlines**

11A: Tigard starts sending Lake Oswego water to help refill Waluga Reservoir (~2 mgd)

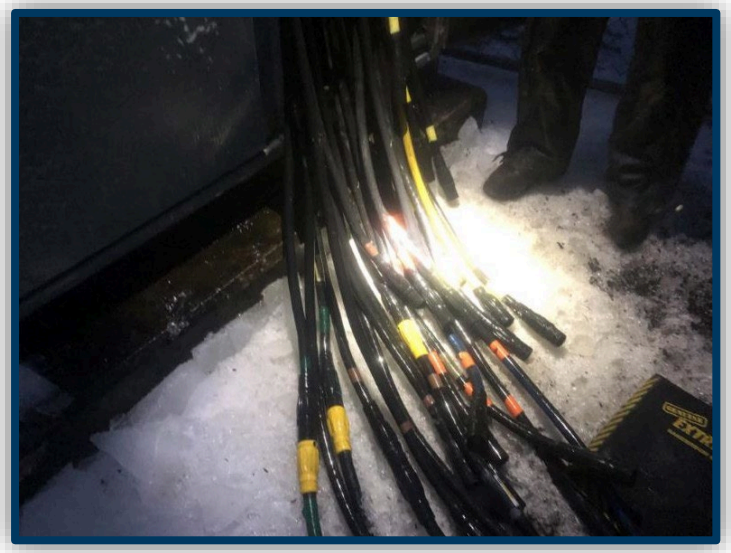
Interstate 84 (Oregon Department of Transportation)

By AP staff (Associated Press) and OPB staff (OPB)
Feb. 14, 2021 9:37 a.m. **Updated:** Feb. 14, 2021 3:53 p.m.

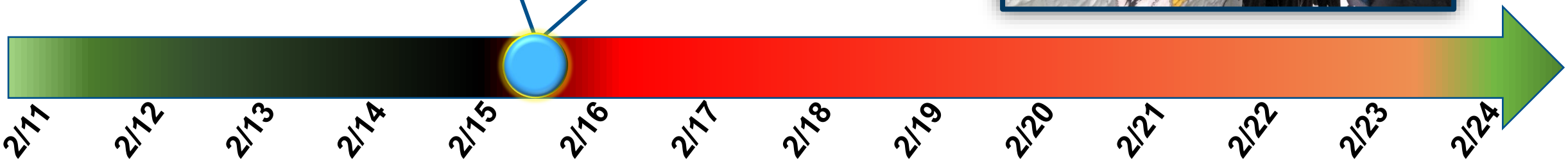
A snowplow clears eastbound Rosa Parks Way towards Vancouver Blvd., Portland, Feb 13, 2021. Snow and ice from the recent storm has made for hazardous driving conditions in the Portland metro area.
Ann Suckow / OPB



Sequence of Events: **Total Blackout**



12P **Generator arrives at WTP**
EC Electric gets to work wiring

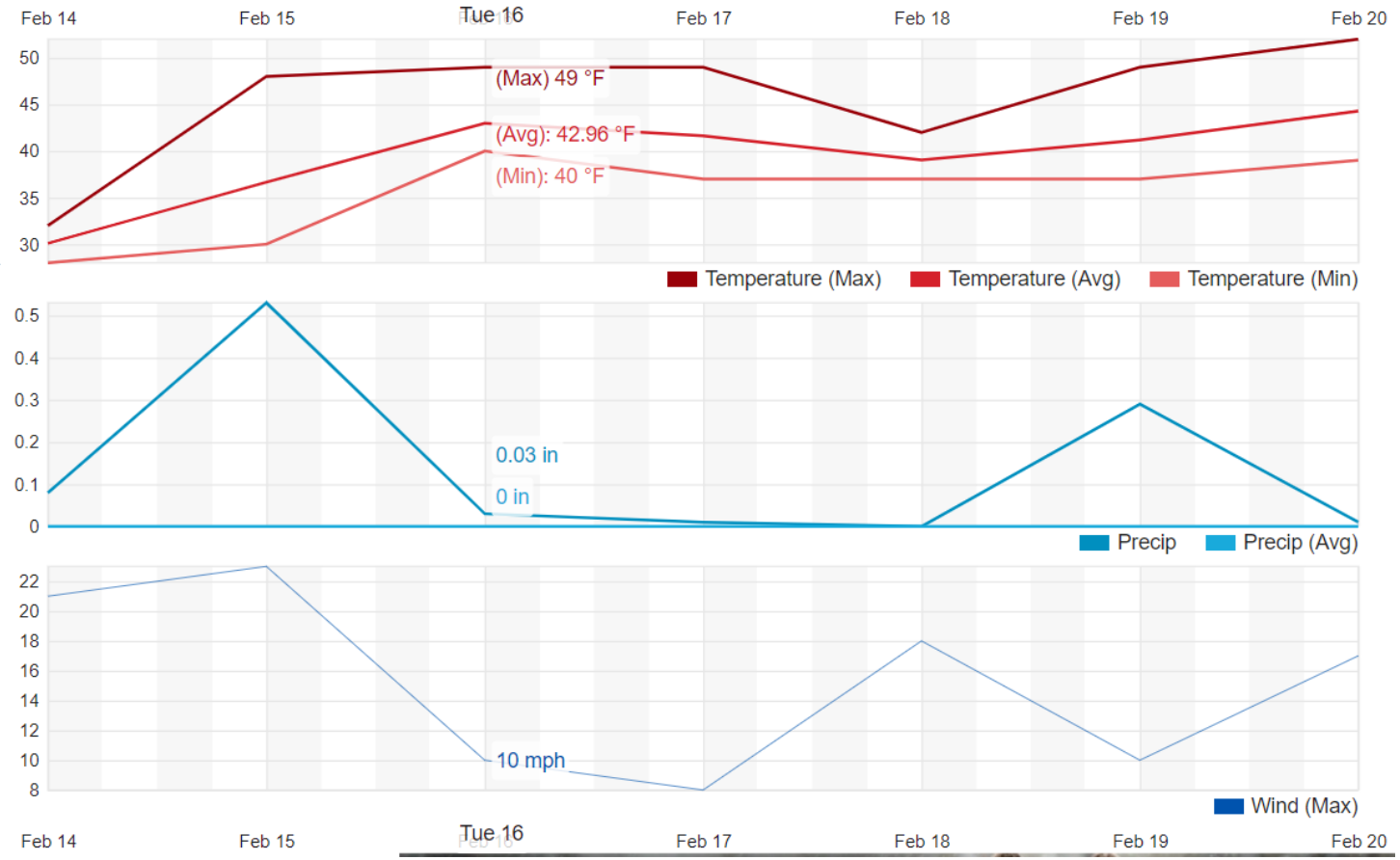


Sequence of Events: **Wires Everywhere**

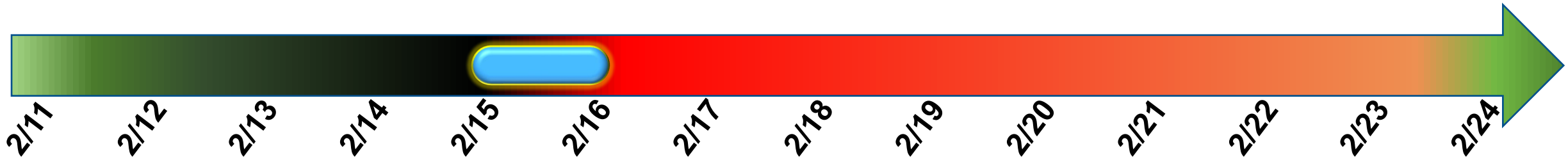
7:30P:

- WTP generator **wiring complete**
- Tigard stops sending water
- **RIPS and WTP start up on generator power!**

Sequence of Events: **Weather Improves**



Weather improves. Temperatures above freezing and lower winds

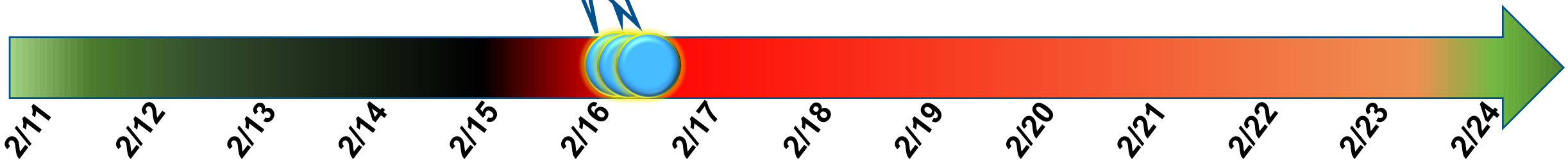


Sequence of Events: **Diesel Power**

Able to run all day on generator power (until ~9p)

Operations is challenged by waste washwater handling

WTP and RIPS shut down overnight to allow staff to return home

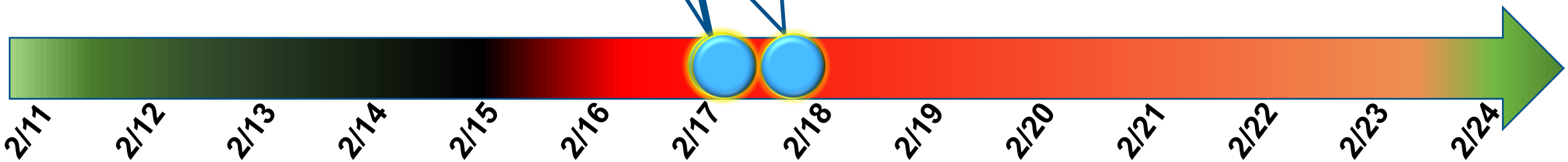


Sequence of Events: **Diesel Power**

WTP start-up hampered by rebooting electronics

Battery Backup at RIPS allows for easier restart in the morning (control system remained online overnight)

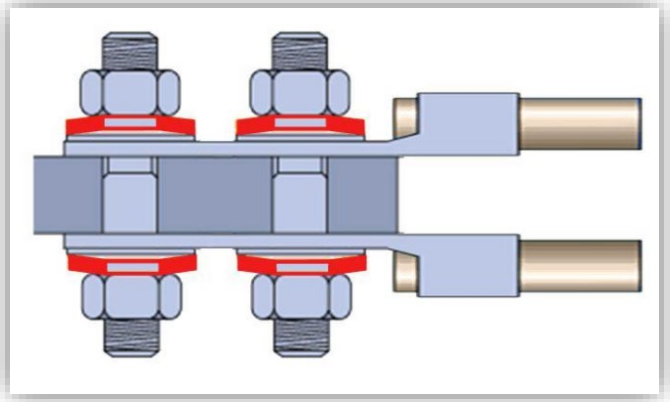
Decision made to leave WTP generator idling all night to provide overnight power while WTP is not producing water

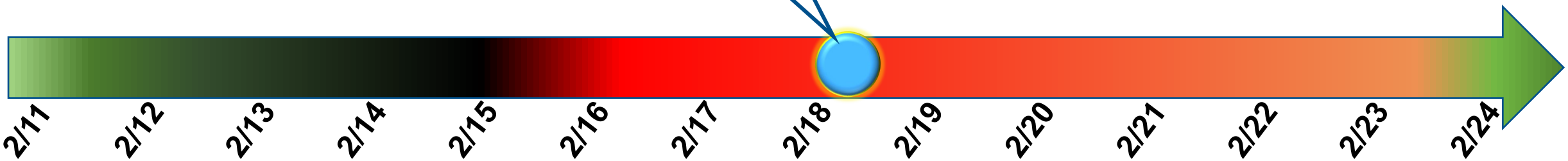


Sequence of Events: **Belleville Washers!**

WTP and RIPS alternate power feed both available. Can't switch back due to needing 'single-use' **Belleville washers.**

Washers had been ordered two days ago, but would not arrive for several days





Sequence of Events: **Waiting and Burning Fuel**

Ran RIPS and WTP on Generators

Required **refueling generators** 2X/day at WTP and 1X/day at RIPS

Made plans for disconnection, calculating fuel use and washer delivery schedule.

Washers arrive late afternoon. Filled system reservoirs with water and shut down WTP and RIPS for switchover

2/11 2/12 2/13 2/14 2/15 2/16 2/17 2/18 2/19 2/20 2/21 2/22 2/23 2/24

Sequence of Events: **Diesel Power**

7:30A: RIPS disconnected from generator
10:30A: RIPS rewired and ready

Challenging getting people/equipment to WTP due to PGE work on HWY 43

10A: WTP disconnected from generator
1:30P: WTP rewired and ready

Normal operations resumes

2/11 2/12 2/13 2/14 2/15 2/16 2/17 2/18 2/19 2/20 2/21 2/22 2/23 2/24

Lessons Learned from Sourcing, Installing, and Recovering from Emergency Standby Power Operations

- Relationship with industrial scale electrical company
  - Most municipal electricians not familiar with medium voltage switchgear
- Communications are difficult
  - Cell phones and internet may be out
- Distribution reservoir monitoring
  - UPS may last 2-3 hours - then what?
  - Distribution crew plowing and clearing streets and not used to taking reads

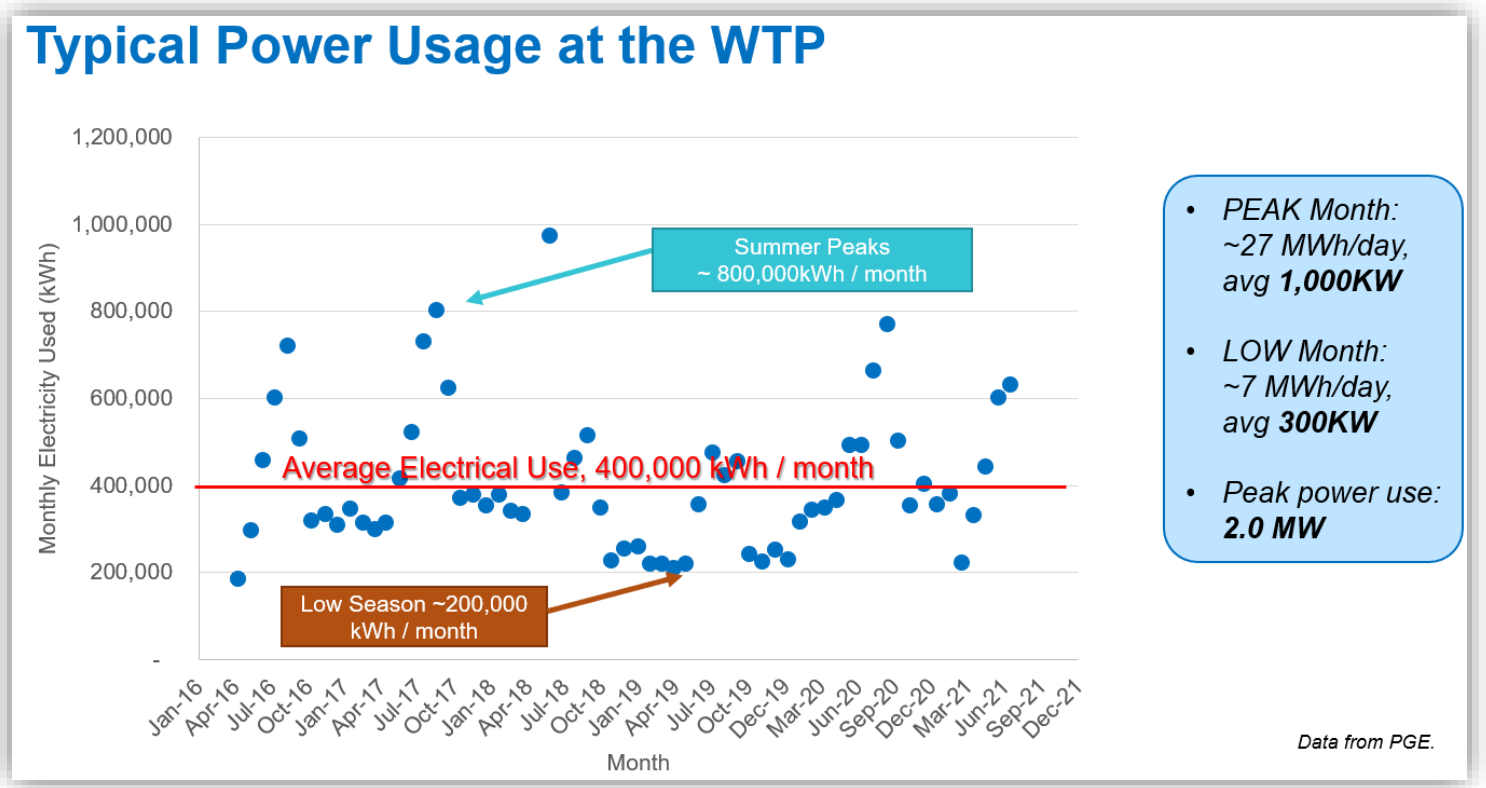
Long Term Solutions

Standby Power Technology Evaluation

Goals, Scenarios, and Power Requirements

Core Project Goals

- Define standby power design criteria
- Identify power requirements for a range of flows and loads
  - From 10 to 38 mgd
  - 400 KW to 1,500 KW for RIPS
  - 1,200 KW to 2,100 KW for WTP
- Provide recommendation for standby power to WTP and RIPS



Ancillary Project Goals:

- Explore alternative standby power approaches

Potential Standby Power Systems

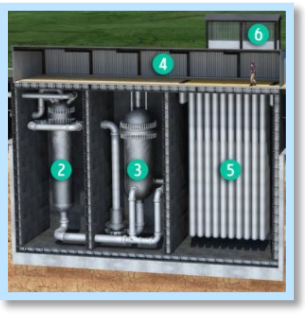
Solar

Grid Scale Batteries

Wind

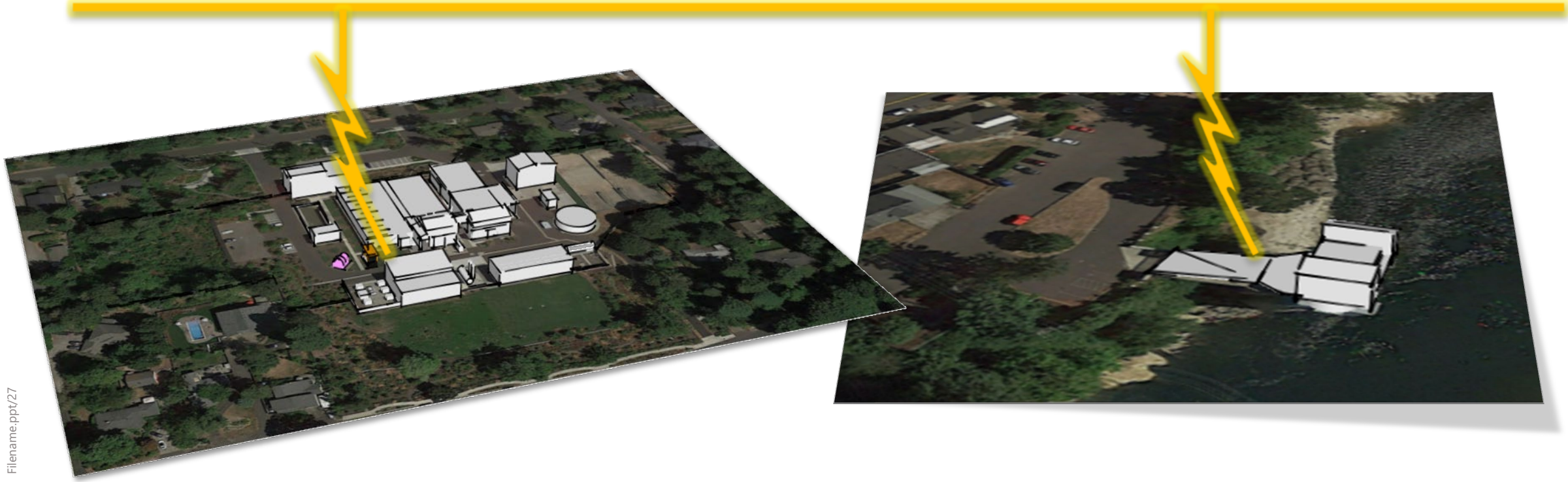
Hydro

Hydrogen Fuel Cell



Micro-Nuclear

Generators (hydrocarbon fuel)



Alternative Standby Power Supply Systems

Existing 30 KW WTP Solar Array

Solar

Even total site coverage does not provide enough power. Long payback period for investment

Cost: **$ to N/A**

Containerized Battery Energy Storage System

Battery Energy Storage

Not viable for operational backup, but perhaps overnight storage

Cost: **$ to $$$$**

Cost Comparison: $ = ~$1M, $$ = ~$5M, $$$ = ~$10M, $$$$ = ~$20M+

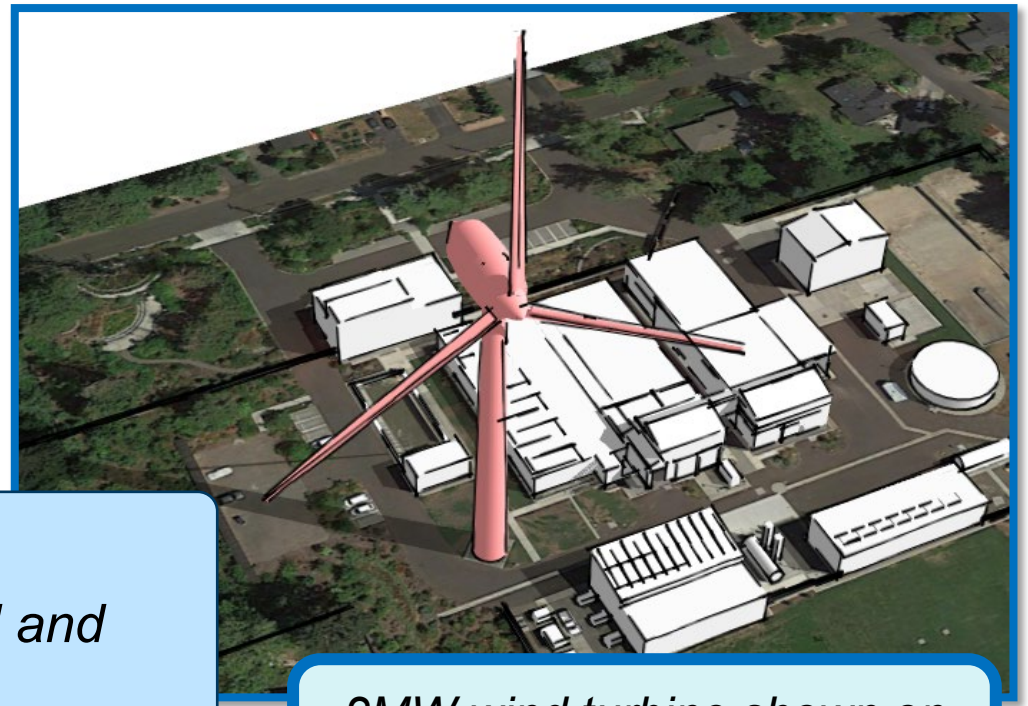
Alternative Standby Power Supply Systems

Willamette Falls, as an example of a 16.9MW hydroelectric facility

Hydroelectric

Is there a nearby dam for sale?

Cost: **$$$$**



2MW wind turbine shown on WTP site for scale only

Wind Power

Would need more wind and land

Cost: **$$ to $$$**

Cost Comparison: $ = ~$1M, $$ = ~$5M, $$$ = ~$10M, $$$$ = ~$20M+

Alternative Standby Power Supply Systems

Hydrogen Fuel Cells

Compact & Efficient, may be viable once hydrogen distribution is sorted

Cost: $$$ to $$$$

Demonstration 2MW Hydrogen Fuel Cell System

Micro-Nuclear Concept Sketch

Image: Ultra Safe Nuclear Corp

Microreactors (nuclear)

Maybe someday (2035?), but… radiation

Cost: **N/A**

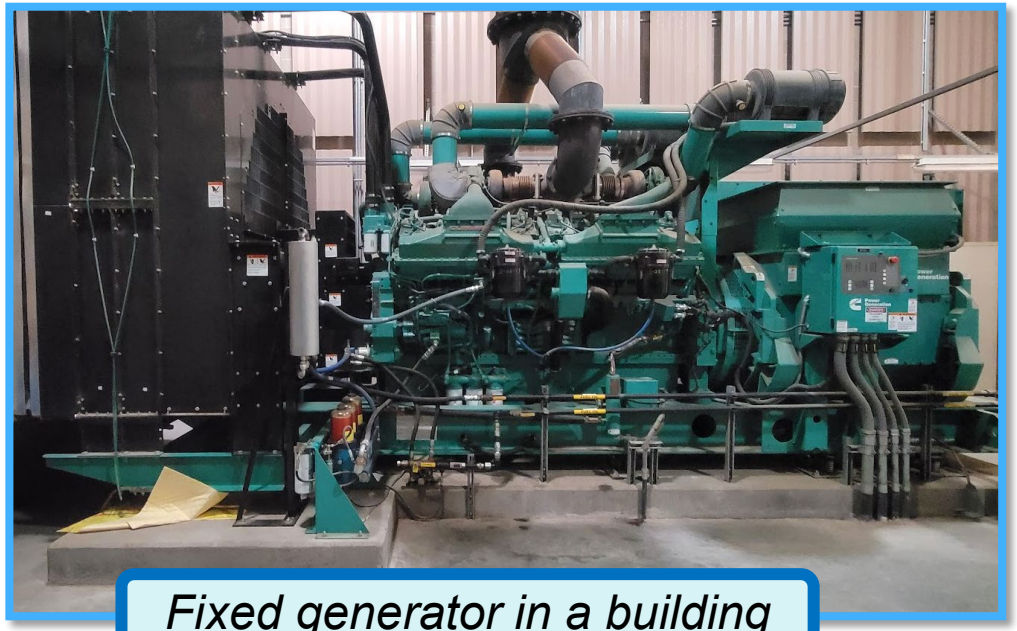
Cost Comparison: $ = ~$1M, $$ = ~$5M, $$$ = ~$10M, $$$$ = ~$20M+

Comparison of Standby Power Alternatives

Hydrocarbon Fuel Generators

Most commonly used technology with compact footprint, fast startup, and reliable performance.

Cost: **$ to $$**



Fixed generator in a building

Portable Generator on a Trailer

Cost Comparison: $ = ~$1M, $$ = ~$5M, $$$ = ~$10M, $$$$ = ~$20M+

Hydrocarbon Fuel Generator Considerations: Fuel Type

Diesel

Benefits

- Common technology
- Fuel generally readily available
- Fast startup and better ability to support large loads
- Safer to use

Drawbacks

- Loud (but can be installed in sound attenuating enclosure)
- Generally more robust, but also maintenance intensive
- Diesel fuel requires maintenance

Natural Gas

Benefits

- Reduced onsite storage for natural gas, gas is piped in
- Less maintenance intensive
- Cleaner burning fuel
- Don’t have to maintain onsite fuel

Drawbacks

- Larger generators (less power ‘per gallon’)
- Generally used for smaller loads
- Relies on natural gas supply pipelines

Propane

Benefits

- Typically lower fuel costs
- Less maintenance intensive (than diesel)

Drawbacks

- Limited availability for larger kW applications
- Large onsite fuel storage required, pressurized flammable gas
- Larger units (than diesel, similar to natural gas)

Hydrocarbon Fuel Generator Configuration Considerations

Fixed Location
Benefits

- Automatic switchover possible
- Can be integrated with fixed aux fuel tanks
- More robust enclosure can be constructed for sound attenuation

Drawbacks

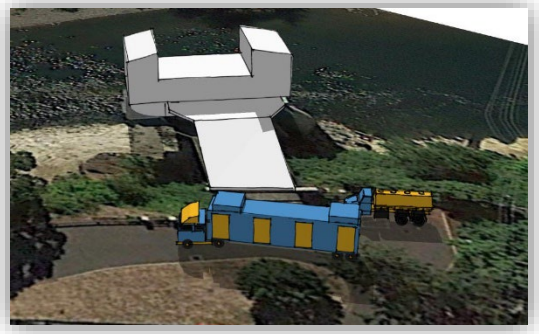
- Permanently takes up site footprint
- Complexity with onsite fuel storage

Portable / Trailer Mounted
Benefits

- Does not have to be located onsite
- Can be maintained offsite

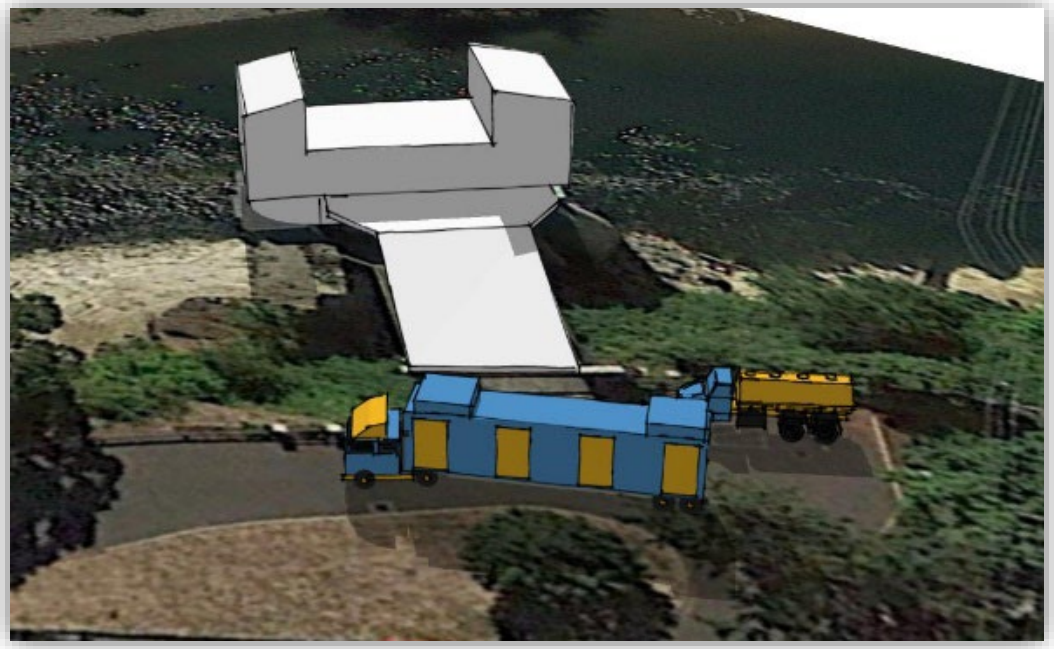
Drawbacks

- Aux fuel tanks separate (onboard fuel limited to ~1,600 gal)
- Must be brought to the site in an emergency
- Requires hookup / installatiom



Long Term Recommendations

- Diesel power
- Fixed at WTP and portable at RIPS
- Quick connect pig-tails at RIPS to make future connection easier
- Improved Distribution Communications
  - 12 hours of battery power
  - Small generator plug ins



Thank You

Questions?

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